CLAIMS

We claim:

1. A Q-switched microlaser comprising:

a) a resonant cavity formed between a first mirror and a second mirror;

b) a Yb^{3+}:YAG medium disposed within said resonant cavity for producing laser gain;

c) a pump source for energizing said gain medium; and

d) a saturable absorber disposed within said resonant cavity; said saturable absorber, said second mirror, and said laser gain being selected so that output pulses having a duration of less than about 1 nanosecond are generated.

e) two undoped pieces diffusion bonded to outer surfaces of saturable absorber and gain medium

2. The laser of claim 1 wherein said second mirror is an output coupler having reflectivity R, $R \leq T_{sa,closed}$, where $T_{sa,closed}$ is the initial , unbleached transmission of said saturable absorber to the microlaser radiation light.

3. The laser of claim 1 wherein said gain medium and said saturable absorber are two separate materials comprised of dopants in a common host and wherein said gain medium and said saturable absorber are joined by diffusion bonding.

4. The laser of claim 3 wherein said gain medium is doped with Yb^3+ and said saturable absorber is doped with Cr^{4+}

5. The laser of claim 3 wherein said host material comprises of YAG.

6. The laser of claim 1 wherein said gain medium and said saturable absorber are the same crystal.

7. The laser of claim 1 wherein said gain medium is diffusion bonded on said saturable absorber.

8. The laser of claim 1, wherein the outer parts of the said laser are composed of undoped pieces of on which dielectric coatings are disposed

9. The laser of claim 1 wherein said pump source comprises an optical fiber for transmitting pump light energy; said optical fiber being optically coupled to said first mirror for pumping said gain medium with said light energy.

10. The laser of claim 9 wherein said optical coupling between said optical fiber and said first mirror is without intermediate focussing optics.

11. The laser of claim 1 wherein the outer parts of undoped YAG pieces of said microlaser are diffusion bonded on said gain medium and said saturable absorber

12. The laser of claim 1 wherein the coatings of said microlaser are applied on the undoped YAG pieces

13. The laser of claim 1 wherein said resonant cavity is less than 10 mm length.

14. The laser of claim 1 wherein said gain medium comprises a solid-state material.

15. The laser of claim 14 wherein said gain medium is consisting of $Yb^{3}+$:YAG optical material

16. The laser of claim 1 wherein said saturable absorber comprises a solid-state material.

17. The laser of Claim 16 wherein said saturable absorber is selected from the group consisting of Cr^{3+}:YAG, LiF:F_2

18. The laser of claim 1 wherein said mirrors are flat, convex-plano, or convex-convex.

19. A passively Q-switched laser based on Yb:YAG as the gain medium comprising:

a) a resonant cavity formed between a first mirror and a second mirror;

b) a gain medium disposed within said resonant cavity for producing laser gain;

c) a laser- diode pump source for energizing said gain medium; and

d) a saturable absorber disposed within said resonant cavity; said saturable absorber, said second mirror, and said laser gain being selected so that output pulses having a power greater than about 100 kilowatts are generated.

e) two undoped pieces disposed within the resonator cavity, diffusion bonded to the said saturable absorber and gain medium. The said first and second mirror are the dielectric coatings disposed on the undoped pieces outer surfaces

20. The laser of claim 19 wherein said second mirror 20 is of reflectivity R, where R is chosen in to be approximately less or equal to the unbleached transmission of saturable absorber

21. A passively Q-switched laser comprising:

a) a resonant cavity formed between a first mirror and a second mirror;

b) a gain medium disposed within said resonant cavity for producing laser gain;

e) a laser-diode pump source for energizing said gain medium; and

d) a saturable absorber disposed within said resonant cavity; said saturable absorber, said second mirror, and said laser gain being selected so that output pulses having a peak power greater than about 100,000 times said laser-diode pump power are generated.

22. The laser of claim 21 wherein said second mirror is of reflectivity R, where R$\leq T_{sa,closed}$, and $T_{sa,closed}$ is the initial , unbleached transmission of said saturable absorber to the microlaser radiation light.